Computer Literacy Skills for Computer Information Systems Majors: A Case Study

David S. McDonald
Computer Information Systems Department
Georgia State University
Atlanta, GA. 30303
davemcdonald@gsu.edu

ABSTRACT

Technology permeates our society. But do institutions of higher education adequately prepare students to use this technology? The definition of computer literacy continues to change as technological innovations are adopted by the marketplace. The specific technology installed in any university setting constantly changes in both sophistication and function. The challenge for universities is to ensure their students meet a minimum level of competency when using new constantly changing technology. As such, universities need to incorporate new, flexible testing tools. This study examines the efforts of one university to test for basic computer skills using an Internet-based, interactive, validated, skills test that already has wide-acceptance in the business community. Over 7000 basic computer skills exams were administered to Computer Information System majors with surprising results.

Keywords: Computer Literacy, IS Education, Information Technology, Computer-based testing

1. INTRODUCTION

Today, the use of computer technology on students' desktops for word processing, communicating with others, preparing class project presentations, searching the Internet, creating computationally-intensive spreadsheets, and record keeping in database management systems is now an accepted norm. Almost any university that creates, stores, and retrieves information as part of its curricula expects students to have appropriate computer technology skills. In fact, most universities assume that new students are computer-literate when they arrive - in contrast to past expectations that all new students would need some basic computer training.

The future ramifications of adopting technology into instructional settings can be significant and far-reaching. As a direct result of technological innovations, methods of information delivery by instructors and reception by students in the future will be very different to the traditional methods employed today (R.P. Vlosky & Wilson, 1998).

University students and instructors alike with little or no computer experience are often overwhelmed by the use of technology in the classroom. On the other end of the spectrum are those who are very proficient and comfortable in using computer-based technology. Yet, the expectation of computer literacy is both a burden and an opportunity. The specific technology installed in any university setting constantly changes in both sophistication and function. Classrooms are being wired so that faculty can use the latest software, incorporate electronic presentations into their teaching, present video, and/or connect to the Internet. The technologies in these high-tech classrooms are often integrated and can include permanently fixed computers, digital video, audio and still photos, CD-ROMs, VCRs, laserdisc players, and audiotape players (Phillips, 2001). Thus, the continually advancing capabilities and the increasing variety of available functions and features result in a continuing need to test for the computer-skills necessary to ensure student success. Universities must accept the challenge of ensuring a technologically-adept student population. Higher education today requires that all students have a certain basic familiarity with the tools used throughout their educational programs. These basic computer skills are a necessary component of a student's college education. This paper describes an action-research case study for a multi-year initiative to incorporate computer software testing for the basic components of computer literacy using an online delivery mechanism. The goals of this effort are to determine 1) the level of computer literacy of the student population as a whole, 2) create an infrastructure to test a large student body, and 3) develop a mechanism by which future students may be tested.

This paper is organized as follows: First a review of the literature describing the current state of computer literacy testing initiatives at institutions of higher education. Next, the computer literacy requirements as currently listed in Georgia State University's catalog. Third, a discussion of the prior enforcement policy that led to the necessity for the creation of a new infrastructure. Fourth, a section is presented listing the rationale and details for the university's request for proposal. Fifth, once the vendor was chosen, a full description of the testing plan and the results of students' tests. Finally, a discussion of these results, the lessons learned, and some conclusions.

1.1 Training - A Necessary Prelude to Education

As an antecedent to this discussion, it is important to make the distinction between *training* and *education*. In a large measure, the future of university business schools, based upon performance criteria, depends upon its learning systems. The perspective taken in this research is that training in certain technology-based tools is a necessary prerequisite for success in any organization's functional area. Thus, as part of any degree program, both education and training must be included in students' degree experiences and must be part of their total educational experience. However, the distinction between education and training is well recognized by both practitioners and academicians and is extremely important when creating and developing educational curricula.

In general, *education* teaches problem-solving approaches while focusing on the ability to reason abstractly. *Training*, on the other hand, provides the tools for implementing problem-solving approaches while focusing on the ability to work concretely (Kolb & Fry, 1975). Whereas education involves an understanding of abstract theory or concepts, training involves gaining the skills necessary to accomplish a task. Education helps the student choose his or her activity; training helps the participant improve his or her performance in it. Both terms are relevant to this research, since learning requires that individuals not only attain certain skill levels to increase performance, but also gain the ability to understand why those skill levels are necessary.

Today's educational programs require that students' master those tools that are incorporated in their curricula. Yet mastery of these tools falls under the realm of training. Utilizing these tools throughout a degree program enhances the student's educational experience. Additionally, future employers expect graduates to have gained not only the requisite knowledge represented by the student's degree program, but also the capability to use the tools that are now part of that education.

2. UNIVERSITY TESTING OF COMPUTER-SKILLS

The need for computer-literate employees and students has been recognized since the beginning of the personal computer revolution (Burgess, Davidson, & Ginter, 1987; Dologite, 1987; LeBold, Zink, Scott, & Salvendy, 1987; Massey & Engelbrecht, 1987). In 1986, Burgess, et al. (Burgess et al., 1987), reported on the public's perception of computer literacy. Their paper examined the increased growth of the microcomputer and people's changing attitude toward them. Specifically, their study examined the need of the entire educational system, primary and secondary schools, as well as universities, to implement coursework aimed at achieving a computer-literate student population. Moreover, they examined the then relatively new trend toward the use of computers in the home, further justifying their assertion of the need for a computer-literate generation of students.

Dologite (1987) was one of the first researchers to perceive the need to measure computer literacy. Between 1985 and 1986, he developed a microcomputer literacy index. His ultimate goal was to measure computer literacy in college students (Dologite, 1987). The index, designed to measure average literacy, was developed from a survey instrument of fifty-four randomly selected students, administered at the beginning of the school year in 1985 and then given again to the same students at the end of the 1986 academic year. He used the comparative literacy average for the two-year period as the basis for the index.

Adding to the work of Dologite, using college of business students, Massey (Massey & Engelbrecht, 1987) provided empirical evidence between the relationship of computer literacy and an improved understanding of word-processing skills. Key limitations to this study, however, were that computer literacy was self-reported and the sample size limited.

A much larger study by LeBold, et al. (LeBold et al., 1987), included a survey of nearly 1000 technically-oriented undergraduate students from computer and electrical engineering, electrical engineering, industrial engineering, computer science, and information systems majors. The study focused on self-reported competencies in computer literacy and computer knowledge which included the ability to use personal computers, software packages, computer systems, hardware, and computer languages. As might be expected, those students majoring in computer science and those with more experience (e.g., juniors as opposed to freshman), demonstrated the best overall competency.

Over the years, a number of studies have shown the importance of computer-literate students in today's academic environments. Some have focused on the modern organization's requirements for a technology-literate workforce (Moody, 1998; Moody, Stewart, & Bolt-Lee, 2002; Phillips, 2001; Vlosky & Summers, 2000). Others have focuses on the characteristics of computer-literate students, such as IQ and personality test scores (Vlosky & Summers, 2000), user diversity and computer-knowledge gap

(Shneiderman, 2000), self-efficacy (Agarwal, Sambamurthy, & Stair, 2000), and users' attitudes (Orr & Poindexter, 2001).

Regardless of the approach, there is a general consensus that today's student must be computer-literate. Moreover, as technology continues to evolve rapidly, the definition of computer literacy continually changes. Thus, there is an even greater need for higher educational institutions to ensure that new students have a certain basic level of technological competency. In fact, for the past decade, there has been a trend by many universities to include a computer literacy course as a requirement in their curricula. A quick Internet search using the Boolean terms "computer literacy" and "Universities" returned a number of universities (see table 1) that indicate they already have implemented a basic computer-skills course for all their students.

University
The University of Massachusetts
Old Dominion University
State University of New York (SUNY) – Buffalo
City University of New York (CUNY)
Western Kentucky University
University of Texas - Arlington
University of Florida
Florida State University
Colorado State
Virginia Tech
Auburn
University of Oklahoma
Utah State University
University of California – Berkeley
Brandeis University
Indiana University
University of Memphis

Table 1- Selected Universities with Required Computer Literacy Courses

This list is by no means exhaustive. In fact, several years ago, the major regional accrediting association for southern schools, the Southern Association of Colleges and Schools (SACS), added the words "the basic use of computers" to the list of skills that graduates of its approved institutions must demonstrate. The same Internet search produced well over a dozen colleges in the United States and another dozen universities located outside the U.S. that now have a basic computer literacy course in their curricula.

3. BASICCOMPUTER-SKILL REQUIREMENTS AT GSU

For many years, the Robinson College of Business at Georgia State University in Atlanta, Georgia, has recognized the need for computer-literate business students. These skills were codified over ten years ago and listed in both the undergraduate and graduate catalogs as "Computer Skills Prerequisites" (CSPs). Initially, there were six areas that required student proficiency. In the late 1990s, two additional areas relating to Internet-based skills were added, bringing the total CSPs to eight. The skills required ranged from the basic concepts, such as turning a computer on and off, copying, deleting, and renaming files, and other basic operating system functions to more complex areas in database management, Internet File Transfer Protocol, and HTML coding. The current CSPs and their objective are listed in table 2 below:

Computer Skill Prerequisite	Learning Objectives
CSP 1: Basic Microcomputing Skills.	Understand the PC and its components; turn on the PC; use command-oriented, windows-based, and LAN operating environments to accomplish tasks such as formatting floppy disks, creating and navigating through directories and subdirectories, creating and deleting files, copying and renaming files, using help screens, loading application software, exiting from application programs and operating environments in an orderly manner, and using appropriate measures to check for and prevent the spread of computer viruses.
Basic Spreadsheet Skills.	Load the spreadsheet software; create, organize, and navigate through spreadsheets; format the spreadsheet or a block of cells; enter and edit formulas, values, and text; copy, move, and protect cells; insert and delete columns and rows; save and retrieve files; print spreadsheets; use financial, statistical, and mathematical functions such as totaling and averaging of rows and columns; create and print charts and graphs, create data tables, invoke existing macros, and use help screens.
CSP 3: Advanced Spreadsheet Skills.	Use advanced spreadsheet features such as database commands and functions; create macros; create menu systems; and develop customized applications.
CSP 4: Basic Database Skills.	Load database software, create databases; enter and edit data; add and delete records; list, query, and generate reports using the database; and use help

Computer Skill Prerequisite	Learning Objectives
	screens.
CSP 5: Advanced Database Skills.	Link databases through keys; create input screens; and develop customized applications.
CSP 6: Word Processing and Presentation Skills.	For word processing: Load the word processing software; create, format, edit, and save documents; copy and move text; adjust margins, indents, and line space; adjust fonts and styles. For presentation graphics: Load the presentation graphics software; choose and modify templates; choose and modify slide layouts; insert slides; modify slide, handout, and note masters; change color schemes; apply effects, animation, and multimedia to slides; run a slide show. For both: Import tables, clip art, and graphs from other applications; use spell-checking; load additional toolbars; use help screens.
CSP 7: Basic Internet Usage.	Send and receive e-mail messages including attachments of files; transfer files with FTP, compress and uncompressed files with utility programs; use search engines to locate documents and find information on the web; navigate the web with a browser including copying/pasting/saving web information; download and set up web browser plug-in programs such as electronic document readers and audio/video players; use web-based clients such as library catalog systems to find specific information.
CSP 8: Advanced Internet Usage.	Create formatted *.html pages with tags including links within and between pages; publish pages to a web site; create image files and embed them in *.html pages.

Table 2 - Computer Skills Prerequisite Objectives

Additionally, for individual courses offered in the Robinson College, none, one, two, or more of the CSP skills could be listed in the undergraduate and graduate catalogs along with other, more traditional, prerequisite requirements. As with any other prerequisite, individual departments within the college (as well as the university) determine which CSP prerequisites are required for individual courses. However, all students in the College are expected to meet the requirements of CSP 1, 2, 6, and 7. These combined basic computer skills are the minimum computer literacy requirements for the College.

Past policy has left it up to the students themselves to determine if they have these necessary skills. The university provided free remedial classes to students who felt they lacked any of the requirements. Formerly, these classes were available in a scheduled classroom setting. More recently, Internet-based online remedial tutorials have replaced classroom instruction.

3.1 Prior Enforcement Policy

Although the basic computer-skills policy has been listed in the graduate and undergraduate catalogs for many years, the University has never had a mechanism by which to enforce these prerequisites. There are a number of reasons why the University has recently decided to enforce these prerequisites. First, the mainframe-based registration system in-place for the past decade would have required a major revision to include these new prerequisites. However, the University is currently switching over to a state-of-the-art registration system. With this new registration system, enforcement of these prerequisites will be a simple procedure. Second, in 1999, University policy changed making it mandatory for all students to have access to their own personal computers. Third, over the years, as technology became more integrated into many of the College of Business courses, faculty complained that valuable classroom time was being spent providing students with remedial software knowledge. This was especially true of the Computer Skills Prerequisites.

4. REQUIREMENTS FOR A PROPOSED SOLUTION

Because of these factors, the College Graduate and Undergraduate Program Committees reviewed the CSP policy and decided it was time to investigate mechanisms to test students for basic computer-literacy skills. In the spring of 2000, these program committees appointed an ad hoc committee for the purpose of investigating different testing and enforcement mechanisms for those objectives listed in table 2. It should be noted that the CSP requirements in Table 2 may not be changed or expanded. They are the officially sanctioned definitions as shown in the College's catalog. These CSPs were developed and mandated by the College's Executive Committee.

The ad hoc committee consisted of faculty from a number of departments within the College. This committee produced the following recommendations:

- First, testing should be done online, using Internet-based testing software as opposed to traditional paper-based testing. Moreover, this Internet-based testing must utilize a relational database to store the results of the students' exams since the new registration system has a relational database for storing students' registration information. Thus, as part of the RFP, a

software supplier was sought that would be willing to develop a software utility to merge the results of the CSP tests with the new registration system. The registration system could be used to enforce CSP prerequisite fields in the same manner as with other prerequisites.

- Second, the exams needed adequate security in the form of password protection and on-site administration, monitored by a proctor. Since the delivery method was the Internet, a student could not be allowed to take the exams anytime, anywhere. If the exams were left "open" on the Internet, there would be nothing to prevent a more computer-literate student taking the exam for a friend. Thus, a requirement for the testing software package was that exams were protected through the use of userids and passwords.
- Similarly, the testing software should have various levels of administrative privileges. The implementation plan called for using Graduate Research Assistants (GRAs) to proctor the exams. This would require the GRAs have a certain level of access to
  - o change session passwords
  - o add and drop students from a given testing session
  - o lookup where a student should be in the overall testing schedule, etc.

  However, a different level of access was needed for the ad hoc committee (or a future CSP exam administrator) to create and modify the existing exams. Finally, general administrative privileges were required for access to the summary student reports, the underlying relational database, and system-software defaults.
- Fourth, since these exams would be given to students in classrooms equipped with computer workstations, it was desirable to have the order of exam questions randomized. Thus, students sitting next to each other would be less likely to have the same test question, thus, decreasing the temptation to cheat.
- Fifth, the software needed to track the time. It is valuable to know how long students spend on completing each of the six exams. In part, the time factor is a surrogate for students' perception of the difficulty of each exam. Moreover, in order to process the entire student body, it was essential that students be limited to a two-hour time slot. The testing software needed to automatically log off students after their allocated time has expired.
- Additionally, the testing software had to limit a given student to a particular time of day, in a designated room, over a period of eight weeks. On the other hand, sample exams had to be available to any student, in any lab, at any time.
- Seventh, the software needed to be scalable. The initial testing group consisted of approximately 1800 students. These students were scheduled to take the exams over an eight-week period. Following this initial group, if successful, the college would process, in additional eight-week periods, groups of approximately 2000 students. The total enrollment for the Robinson College of Business is approximately 8500 students. Thus, within the first year, the plan called for testing all of the College's students. The plan then called for testing the University's remaining 18,000 students over the next two years. As the database increased in size, it was important to ensure that the software performance would not degrade.
- Similarly, the software had to have an easy-to-use, scalable reporting facility. Students taking an exam required a performance report that could be saved to a floppy disk. Not all the classrooms used for testing had printers. In reality, it would be best if students were not allowed to use printers. With a total of 26,000 students, each generating a *minimum* of six reports (assuming they passed each of the six exams on their first attempt), the paper consumption would be astronomical – a minimum of 312 reams of paper! This does not include the additional costs of maintaining the printers and the purchase of printer consumables (toner cartridges, imaging units, etc.). Additionally, university administrators and the Registrar required easy-to-use, individual, and summary reporting capabilities. Future exam administrators would need
  - o to know which exam questions posed the greatest problems
  - o to know what the failure rate was for any given exam
  - o a lookup feature to print out any given student's exam scores
  - o the ability to break students out into varying groups, such as those from the Finance Department or the CIS Department, or undergraduates from graduate students.
- The software needed to be flexible. There had to be a sufficiently large database of exam questions so that each of the stated learning objectives listed in table 2 could be met.
- The questions for the tests had to be pre-validated.
- With Microsoft dominating the desktop market (Moore, 2002), the tools required for use in the classroom are all based on the Microsoft Office® suite of applications. These include Microsoft Word, PowerPoint, Excel, and Access. Therefore, proficiency in these tools could be used as a surrogate to proficiency in the basic skills prerequisites.
- The selected software provider would be required to customize its software with an archiving utility program. This was necessary to limit the size of the testing software database by removing and archiving students' exam results once they had been transferred into the registration system. However, the archival software utility also needed the capability to access the archived records if necessary.
- Finally, and most importantly, the testing methodology should allow for interactive testing on

"live" copies of the MS Office suite of applications. An interactive testing methodology is superior to exams with multiple-choice questions. Optimally, students would be given actual tasks to accomplish in a word processor, spreadsheet, presentation or database package. Since all Windows applications allow for more than one way to accomplish most tasks, this was no trivial requirement. For example, if a student's task was to change the typeface of a word to **BOLD**, then the testing software had to have the capability of recognizing the multiple methods to accomplish this task; i.e., the student may right-click a mouse to get a FONT menu choice, or the student may click on the toolbar icon for boldface, or the student could use the main menu FORMAT command and then the sub-menu FONT choice. Thus, a necessary requirement for the testing software was to recognize multiple input methods by the students taking the exams.

After an eighteen-month search, with visits and demonstrations given by a number of vendors, including the Advantage® testing package from McGraw-Hill and SkillCheck® from Prentice-Hall, DistributeIT® from Bandwiz, and the ad hoc committee chose Thomson Learning, Inc. and their SAM2000® software. SAM2000® met or exceeded all of the committee's requirements. One important consideration was that SAM2000® used SQL Server, an enterprise database management system, to store results, where many other testing software vendors were still using MS Access. MS Access would not meet the committee's scalability requirement.

Moreover, the exam questions in the SAM2000® software package had been validated. The package was developed by Thomson Learning, Inc. in association with Microsoft Corporation. The primary market for this testing package is corporate America for ensuring employee knowledge in the key concepts from the Microsoft Office suite of applications. As such, any exam created with the test bank of questions was Microsoft Office User Specialist (MOUS) certified — providing the prospective employer with a computer literacy measuring tool of which they are already familiar. By earning a MOUS certification upon the successful completion of CSP testing, students also benefited. From their feedback, they believed a resume showing MOUS certification would provide them with an advantage in post-graduation job searches. Further information may be found at: http://www.microsoft.com/traincert/mcp/officespecialist/requirements.asp.

Also, although Thomson Learning would not give permission to display actual exam questions, they were amenable to including a screen-capture from a SAM2000® sample exam (see appendix). Major tasks/objectives are listed as section headings. Subtasks are then chosen from which the actual interactive tasks are created. An interactive demo can be found at: http://www.course.com/testandtrain/sam2000.cfm.

Additionally, Thomson Learning, Inc. was willing to forgo the licensing fees as long as the University recommended a series of Course Technology books as remedial reading material for those students failing to pass the exams (Course Technology is a division of Thomson Learning, Inc.). In essence, the contract provided the University with $100,000 worth of licenses, enough to cover testing the entire student population, at no charge. However, the University bookstore had to agree to stock sufficient copies of Course Technology's remedial books. Although Course Technology books were the main source of remedial training, this was not the only source of help provided to the student. The University also licenses the eLearning package, a self-paced, online tutorial, for remedial assistance in using Microsoft Office products. Ironically, Course Technology's TOM (training online manager) package was deemed too expensive for use by the entire university.

It should be noted that this was the first time that Thomson had made such an arrangement. This project was as much a pilot for Thomson Learning, Inc. as it was for the University. Since the University had very high enrollments, Thomson hoped that the additional book sales would offset the cost of the licenses. To this author's knowledge, Thomson has not made this offer to any other educational institution.

5. IMPLEMENTATION

The strategic plan, developed by the ad hoc committee, and with the approval of the Associate Dean, called for testing one of the College's largest departments, the Computer Information Systems (CIS) Department. The committee believed that students with this major would be better suited to work through the expected problems that occur with the implementation of any large-scale, technical project. Also, unlike any other departments within the College, the CIS Department required its students to have knowledge of all of the CSPs. Moreover, the CIS Department consisted of 1800 graduate and undergraduate students, a sufficiently large number to adequately pilot the testing software package. The CIS Department was scheduled to begin testing in January 2002. After refining a suitable testing protocol with the CIS Department, the plan called for testing the rest of the Robinson College of Business during the 2003-2004 academic year. Finally, testing would begin for the other colleges in the University beginning with the 2004 academic year.

The ad hoc committee created a series of six, one-hour exams. The SAM2000® software package allowed for faculty to choose amongst 30,000 questions in a pre-defined test bank. The questions were chosen that best matched the learning objectives shown in table 2. As mentioned previously, each of these questions had been previously validated by Thomson Learning and Microsoft Corporation. Each member of the committee tested their own knowledge as well as the time

required to take the exams. For the faculty, most were able to finish the exam in approximately 20 minutes. Thus, the one-hour limit given to the students should have been more than adequate.

CSPs 1, 6, & 7 were combined into two single exams, one focused on basic computer, Internet, and word processing skills, while the other focused on basic computer, Internet, and presentation software skills. Individual exams were created for CSPs 2, 3, 4, and 5. These exams tested for beginning and intermediate proficiency in spreadsheet and database skills, respectively. At the time testing began, the SAM2000® software did not have a module for testing CSP 8, Advanced Internet Usage. If the testing program proved successful, Thomson Learning was willing to create a custom module for SAM2000® which would test for this last CSP.

In January 2002, the mainframe registration system was still in use. It was scheduled for replacement in the following semester (June 2002). As a result, a Visual BASIC program was developed to take the student information from a mainframe, COBOL, fixed-field file and convert it into a Microsoft Access relational database file. Then, a second Visual BASIC program was created to read the Microsoft Access student database file and append appointment slots for specific two-hour time slots in eight different computer-equipped classrooms. This program determined the number of workstations available in each of the eight classrooms and automatically allocated the correct number of students in a room until appointment days and times were generated for all 1800 CIS majors. Finally, a local printing company used the Microsoft Access database file and a Microsoft Word mail merge document to produce appointment postcards for each of the CIS majors. These postcards were sent to students providing them with their allocated two-hour exam periods and room. The appointment card also listed a Web site for students to gain further information, including a listing of Frequently Asked Questions (FAQs) (see Appendix – "CSP Exam FAQs"). The day and time slot given to the student was available from January 7, 2002 to February 24, 2002. Students were expected to take *and* pass all six exams in this eight-week time frame. A minimum score of 65 was considered a passing grade. Each exam could be taken as many times as necessary to achieve a passing grade.

Upon the completion of an exam, students could download a Microsoft Word report indicating exactly which questions they missed. Additionally, for any questions missed, the report recommended a Course Technology book, with the section and page numbers of where the correct procedures could be found. The ad hoc committee felt that it would be beneficial to require failing students to purchase the book. The book would provide these deficient students with a valuable resource for future use in their academic careers. Also, as mentioned earlier, the sale of these Course Technology books enabled the University's use of the SAM2000® software without a licensing fee.

The college recommended that students take the exams as early as possible during the eight-week period. They were also warned that failure to complete and pass each exam in the allocated timeframe could result in a future "lock-out" of registering for CIS courses that had CSP prerequisites. Finally, students were notified that this was not just a CIS Department initiative; rather it was a new Robinson College of Business policy with the CIS Department being the first in the College to take these exams. The rationale for this statement was two-fold. First, the college did not want students switching majors to avoid taking the exams. And second, it wanted the "grapevine" to prepare the other students in the College that basic computer-skill testing was going in effect for them within the coming year. According to the initial schedule, CSP testing, as part of the 100% prerequisite enforcement policy, would begin in the fall semester, 2003. The only exception was for students who would be graduating in the spring semester, 2002.

5.1 Procedure

The author was asked to act as the administrator for the CSP testing initiative. He interfaced with the College administration and hired ten GRAs to proctor the exam sessions. These GRAs received two training lessons prior to their first testing session with the students. The first lesson, led by Thomson Learning training staff, dealt with the complexities of the SAM2000® software. The second lesson, administered by the faculty administrator, established student testing-session procedures. After this training session, each GRA was given a handout that listed the procedures he or she needed to perform for each of their sessions (see Appendix – "CSP Exam Instructions for Proctors").

Each GRA proctor was given a report indicating which students were scheduled in which classrooms for each two-hour time slot. Upon arrival, a student checked in with the GRA, presenting his or her picture ID. Students could come at anytime during their allotted two-hour time slot; however, five minutes before the end of a two-hour slot, the GRA would announce the classroom had to be cleared for the next group of students.

Upon check-in, students were handed a basic instruction sheet for logging in, starting an exam, and getting a report of their results (see Appendix – "CSP Testing Instructions for Students"). These instructions were also placed on the classroom whiteboards. The GRA proctors were well trained in solutions to most of the common problems that might arise. Network-related and other technical problems occurred on some workstations; however, these students were simply moved to another computer and an "out-of-order" sign was placed on the problem machine. The GRA proctor would then notify the faculty administrator of the technical problem and he, in turn, would notify the workstation technical support staff. Most problem workstations were fixed within 48 hours.

	CSP 1,6,7 - Word Processing	CSP 1,6,7 - Presentation Skills	CSP 2 - Basic Spreadsheet	CSP 3 - Advanced Spreadsheet	CSP 4 - Basic Database	CSP 5 - Advanced Database
U.G. Failure Rate	10.6%	53.6%	44.0%	48.6%	71.0%	77.4%
U.G. Pass Rate	89.4%	46.4%	55.0%	51.4%	29.0%	22.6%
U.G. Exams Administered	582	1048	908	702	1127	923
Grad Failure Rate	4.0%	23.6%	21.0%	22.2%	41.3%	58.4%
Grad Pass Rate	96.0%	76.4%	79.0 %	77.8%	58.7%	41.6%
Grad Exams Administered	228	289	276	257	351	392

Table 3 - Failure rates for individual exams

A majority of the testing was scheduled over Friday afternoons from 12 noon to 10 PM, Saturdays and Sundays from 8 AM to 10 PM. These were the only days and times the University had sufficient computer workstations classroom resources available. However,

for those students who had conflicts with the assigned weekend time periods, the University assigned us two additional workstation classrooms for use on a limited schedule on Wednesdays and Thursdays. The CIS Department administrative staff fielded many of the students' phone queries.

6. RESULTS

The results of the two-month pilot were somewhat surprising, but not totally unexpected. 28.4% of graduate students majoring in Computer Information Systems failed to pass all six exams. For undergraduate students, the results were much worse. Over 50% of CIS undergraduate majors were not able to successfully pass the six computer literacy exams (see table 3). Only those exams that were completed within the allocated time period were included. Thus, if students started an exam just before their allocated two-hour period expired, and did not complete the exam, they were not given a failing grade. Tables 3 and 4 include only those students who had sufficient time to take the exam.

	Undergraduate CIS Majors	Graduate CIS Majors
Avg. Failure Rate	51.0%	28.4%
Avg. Pass Rate	49.0%	71.6%
Number of Exams Administered	5,290	1,793

Table 4 – Summary average failure rates for all six exams

Table 4 shows the results of each of the individual CSP exams for both graduate and undergraduate CIS majors. This breakdown indicates the strengths and weaknesses for each group. As might be expected, all students had the least problems mastering word processing skills. The undergraduate failure rate was approximately 10%, while only 4% of graduate students failed the same exams.

The real surprise was the consistently poor performance on the other exams from undergraduate students majoring in Computer Information Systems. Intuitively, one would expect this group of students to enter this major with greater computer literacy. However, the results of this study indicate, with the exception of word processing skills, the next most accomplished tool was basic spreadsheet skills with a very high failure rate of 44%.

Also surprising was the poor performance of undergraduates in presentation software skills. The Robinson College of Business undergraduate courses have a great many student project presentations as a requirement of the BBA degree program. As such, students often use presentation software to present their group findings to their instructor and classmates. This study indicates that over 50% of the tested students could not pass the basic skill proficiency exam in this area.

Less surprising was the extremely poor performance in database management skills. Close to three-quarters of the undergraduate majors failed these proficiency exams. Although other departments within the college may not choose to test students' skills in database management systems, it is an essential skill for the CIS major. Whereas students must obtain the other basic computer-skills on their own, the database skills are taught in a sophomore-level course to *all* College of Business students in a required course. These results tend to support past studies that show students retain very little of instructor-presented classroom material (Carroll & Aaronson, 1988; Cooper & Krinsky, 1991; Craik & Tulving, 1975; Davis & Bostrom, 1993). Moreover, these results are consistent with those obtained from the ETS assessment exam, a standardized Princeton exit exam used by the College of Business to measure the knowledge undergraduates retain in their degree programs. The ETS exam tests undergraduate majors in their knowledge in eight subject areas (e.g., accounting, marketing, finance, business statistics, etc). Students' retention rates vary from semester to semester, depending on subject area. However, typically students retain between 35-65% of a given subject.

Thus, a pass rate of 29% for database management system knowledge is not unexpected – especially when one considers the complexity of Microsoft Access.

The undergraduate findings are relatively consistent with the Vlosky and Summers (R.P. Vlosky & Summers, 2000) study on basic computer literacy skills. In their study, they reported over 40 per cent of respondents consider themselves not to be proficient in using word processors, the World Wide Web, or e-mail programs. However, the proficiency levels dropped dramatically for other important technologies such as basic PC skills (54.8 per cent not proficient), spreadsheets (76.0 per cent), presentation graphics (84.9 per cent), and databases (92.3 per cent).

Graduate students faired much better with presentation and spreadsheet skills, failing approximately 20% of the time. As with the undergraduates, the failure rate more than doubles when testing for database management skills, failing the basic database exam 41% of the time and the advanced database skills 58% of the time. Again, proficiency in these exams is expected of the CIS major, but would not be required for most courses in other departments in the college.

7. THE PRESENT SITUATION

The College administration believed that the CIS majors would fair much better on these exams. The use of these majors was done primarily to determine if the testing software and the methodology were sound. The unexpectedly poor results in computer literacy skills of a supposedly more computer-literate group resulted in the administration re-examining the entire computer literacy issue.

The College administrators' assumption that the majority of business students have the necessary skills to pursue their undergraduate and graduate degree programs is not warranted. As a result of this pilot program, plans are now underway to introduce a required freshman-level course for Robinson College of Business students. This will be an introductory course of basic business concepts. The plan is to provide students with a course that will both train and educate the students. This course will have both a lecture component and a lab component. Regular CIS Department faculty, focusing on introductory business concepts, will teach the lecture component. Graduate research assistants, skilled in the Microsoft Office tools, will teach the lab component. Lab assignments, making use of the appropriate Microsoft Office tool, will be used to apply the business concepts from the lectures. The final exam will test students' understanding of basic business concepts, as well as test their ability to implement these concepts with the latest hardware and software tools. This new course is planned for a fall of 2003 implementation.

The plan also includes the continued use of the SAM2000® exam. Students who truly have the necessary computer literacy skills can exempt out of the planned course by passing the SAM2000® exams. These students will have the same freshman course choices that are currently available.

8. LESSONS LEARNED

From a positive perspective, the feasibility of establishing a testing infrastructure was definitely viable. All the vendors contacted by the university were anxious to help with the specific needs and problems within our organization. The book vendors, who have a much greater vested interest in the university, were especially helpful. The timetable of testing 26,000 students in a three year period was also doable...as was obtaining the necessary classroom space and computer workstations. The overall expense for this testing was quite reasonable. If we continued, the primary costs would have been that of a permanent administrator for the program as well as ten GRAs per semester for proctoring the exam.

The major obstacle was the lack of support from certain new Dean's office personnel. These administrators were not involved in the prior two years of planning for the CSP testing program. As a result, even though students were told that these exams were essential for continuing with their degree program, exceptions were given when some students complained to this new administrator. Thus, the credibility of statements made to the students as to the necessity of these exams was undermined. Ultimately, the new member of the Dean's office made a decision to exempt graduate students from taking the CSP exams. This resulted in the demise of the online testing. Undergraduates soon realized that if they complained enough, the Dean's office would back away from the testing initiative.

Overall, the methodology developed was sound. Unfortunately, the lack of authoritative support was the key reason why the testing was forced to move into the classroom. Ultimately, this move to a classroom environment will cost the University far more in dollars, resources, and students' goodwill. As is often the case in the business world, this initiative failed when a member of the team of top management failed to provide commitment and support to the project.

9. CONCLUSIONS AND IMPLICATIONS

This study focused on the computer literacy of university students majoring in computer information systems at Georgia State University. The findings may also be as applicable to our higher education system, the training needs of the workplace, and the necessity for life-long learning essential in our technologically-intensive society. Although current University policy states that students must have access to their own computers, this case study indicates that increased access to the technology is no guarantor of the skills required to succeed at school or at work. It is imperative that no assumption is made that students will be motivated to learn the tools they will need simply by having greater access to

computers in general. The results of this case suggest that institutions of higher education as well as organizations must provide relevant, structured computer software instruction for students and employees.

Although this is a single case, albeit with a large number of participants, there are still the questions with regards to internal and external validity. With a case study, one may not imply causal interpretability. Thus, the results of this study indicate a poor performance by all CIS majors in basic computer literacy skills, but there is no way to imply why this condition exists or whether in-place procedures are helping to alleviate the pervasive problem with lack of computer software skills. The testing was done to all students, not one group receiving a treatment while another acted as a control.
External validity of a case is equally suspect. Perhaps the results we obtained at Georgia State had regional implications. Would the same results have occurred at a California university? At a European institute? The generalizability of this case is limited only to those institutions and conditions that were prevalent when we administered these exams. Currently, the SAM testing software is now designed for the Office XP™ suite of applications. Would the same group of CIS majors score the same on this newer exam as they did on the one they took over a year ago? These are the questions that should always be considered when presenting a case. The true value of the case is what the researchers learned by going through a process (see "Lessons Learned" section above).

The challenge for educators, however, remains. Mechanisms must be created that will allow students to deal with the pace of technology change and the variety of equipment that they will encounter after their educational experience. Universities addressing the issues relating to constantly innovating technologies will produce students with greater appeal to a broader audience and markets. Keeping pace with progress to graduate computer-literate students is an appealing strategy is to make students more competitive for the demands of today's job market.

10. REFERENCES

Agarwal, R., V. Sambamurthy, & R.M. Stair. (2000). "Research report: The evolving relationship between general and specific self-efficacy - An empirical assessment". Information Systems Research, Vol. 11, No. 4, pp. 418-430.

Burgess, B.E., B. Davidson, & P.M. Ginter. (1987). "Computer literacy: The quiet revolution. A status report". Interface, Vol. 9, No. 1, pp. 34-44.

Carroll, J.M., & A.P. Aaronson. (1988). "Learning By Doing With Simulated Intelligent Help". Communications of the ACM, Vol. 31, No. 9, pp. 1064-1078.

Cooper, R.G., & I. Krinsky. (1991, October). "General Studies and Cooperative Learning: Being Creative (Phase 2)". Paper presented at the ISETA.

Craik, P.I.M., & E. Tulving. (1975). "Depth of Processing and the Retention of Words In Episodic Memory". Journal of Experimental Psychology, Vol. 104, No., pp. 269-294.

Davis, S.A., & Robert P. Bostrom. (1993). "Training End Users: An Experimental Investigation of The Roles of The Computer Interface and Training Methods". MISQ, Vol. 17, No. 2, pp. 61-85.

Dologite, D.G. (1987). "Measuring microcomputer literacy". Journal of Educational Technology Systems, Vol. 16, No. 1, pp. 29-44.

Kolb, David A., & R. Fry. (1975). Toward an Applied Theory of Experiential Learning. In G. L. Cooper (Ed.), *Theories of Group Processes*. New York: John Wiley and Sons.

LeBold, W.K., W.T. Zink, S.E. Scott, & G. Salvendy. (1987). "Programming perceptions and computer literacy of students enrolled in computer-related curricula". IEEE Transactions on Education, Vol. E-30, No. 4, pp. 201-211.

Massey, T.K. Jr. , & J.W. Engelbrecht. (1987). "Empirical effects of selected antecedent computer literacy skills on computer orientation of college students". Computer Education, Vol. 11, No. 3, pp. 177-180.

Moody, J. (1998). "Providing proof of proficiencies: Software skills for senior business administration majors". Paper presented at the The 1997 Annual Meeting of the Decision Science Institute, San Diego, CA.

Moody, J., B. Stewart, & C. Bolt-Lee. (2002). "Showing the skilled business graduate: Expanding the toolkit". Business Communications Quarterly, Vol. 65, No. 1, pp. 21-36.

Moore, Joanna. (2002, July 30). Lotus Ships Discovery Server 2.0, Looks at First Year in KM World. *e-Pro Mag.com,* 1.

Orr, C., Allen, D., & S. Poindexter. (2001). "The effect of individual differences on computer attitudes: An empirical study". Journal of End User Computing, Vol. 13, No. 2, pp. 23-39.

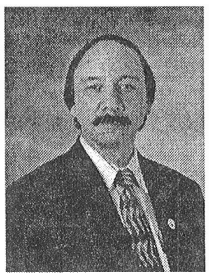
Phillips, J.T. (2001). "Embracing the challenge of leadership". Information Management Journal, Vol. 35, No. 3, pp. 58-61.

Shneiderman, B. (2000). "Universal usability". Communications of the ACM, Vol. 43, No. 5, pp. 84-91.

Vlosky, R.P. , & T.A. Summers. (2000). "Computer technology in the College of Agriculture classroom at Louisiana State University". Bradford, Vol. 17, No. 3, pp. 81-84.

Vlosky, R.P., & D.T. Wilson. (1998). "An essay on technology in the classroom: teaching marketing in the 21st Century". Journal of Business to Business Marketing, Vol. 5, No. 1/2, pp. 145-156.

AUTHOR BIOGRAPHY



David S. McDonald serves as the Academic Program Director for the Computer Information Systems Department at Georgia State University in Atlanta, Georgia. He has a strong belief that new and innovative approaches to technology are mandatory in today's marketplace. Accomplishing this requires increased partnerships among academia, businesses, consulting firms and government agencies. Dr. McDonald's research areas are in the applied use of multimedia systems, inter-organizational systems, organizational learning, and innovative instructional systems. Additionally, he works closely with the State of Georgia as well as many of the Fortune 500 firms based in Atlanta.

APPENDIX

CSP Exam Instructions for Proctors

To set a section password:

1) Go to "Schedule"
2) Highlight the exam and section with the proper room/time
3) Click on "Modify"
4) Enter a password (Change at the beginning of every two hour shift)
5) You may need to overwrite an old password

To check in students for a given time slot:

1) Always stop students at the door and check their actual Student ID cards.
2) Check their name off on the list given to you. CAREFULL! Rooms were assigned by last name. You will have many people with the same last name in your section. Make sure the last six digits of their student ID matches the last 6 digits of the password.
3) Place checkmark between the second and third columns
4) Give the student their UserID (column 4) and password (column 3). Again, make sure you give the CORRECT UserID.
5) Let them know their password is the last six digits of their SS#

In large letters over the top of the whiteboard in your classroom please write:

PLEASE USE THE "EXIT" BUTTON TO QUIT!!!!

Make sure all of the following text is written on one part of the whiteboard in your classroom:

Instructions to take exam

Password for time slot *2:00PM – 4:00PM (for example)* is "xxxxxxx" *(where xxxxx is a six or more character password that you made up)*

Start the SAM2000® testing software
Login
Select "Student" button
First time users click "OK" to license agreement
Click "OK" to Section Acceptance dialog box
Select exam you wish to take and then click "Launch" tab
Enter the exam password

On another area of the whiteboard write the following:

Instructions to get a report of your exam results:

After logging in, select "Student" button
Click on Available Results exam for which you want a report (bottom half of the screen)
Use the drop down list to select "Exam Study Guide"
Click on "Create Reports"
Click on the Export icon at the top of the screen
Scroll down to MS Word format
Name your report and save it to a floppy

CSP Testing Instructions for Students

Instructions to take exam
Password for time slot *2:00PM – 4:00PM (for example)* is "xxxxxxx" *(where xxxxx is a six or more character password that you made up)*

- ☐ Start the SAM2000 testing software
- ☐ Login
- ☐ Select "Student" button
- ☐ First time users click "OK" to license agreement
- ☐ Click "OK" to Section Acceptance dialog box
- ☐ Select exam you wish to take and then click "Launch" tab
- ☐ Enter the exam password

Instructions to get a report of your exam results

- ☐ After logging in, select "Student" button
- ☐ In the "Report Type" column (bottom half of the screen),
- ☐ Click on "Exam Result – Overall", or select "Exam Study Guide"
- ☐ Click on "Create Reports"
- ☐ Click on the "Export icon" at the top of the screen. The icon looks like an envelope with a red arrow in the middle.
- ☐ Scroll down to MS Word format
- ☐ Name your report and save it to a floppy

Return to your proctor when finish the test!

CSP Exam FAQs

I'm a CIS Major. Can't it be assumed that I already have basic computer-skill knowledge?

NO. We have discovered that computer literacy is similar to plain literacy (the ability to read and write) in that people are very good at covering up the fact that they don't have this basic societal knowledge. Ultimately, a student will be at a disadvantage in today's business environment. CSP testing gives us, and your future employer, a guarantor of your computer-skills.

I'm a CIS Major, but I do not have an appointment to take the CSP exam?

Students who were CIS Majors at the end of last semester are the only ones who received appointment cards. All CIS Majors as well as all students at GSU will eventually be tested. Those that are new majors and did not make it into this round of testing will receive an appointment card later.

The course that I am now taking has CSP prerequisites. Will I be dropped from this course?

CSPs will not be enforced until we have the new registration system in place. The earliest this will occur is the Summer semester. However, it is more likely to start in the Fall. CSPs are still in your syllabus, as they always have been. CSP knowledge has always been a requirement of your courses, although we have never before been able to ENFORCE them. Now, we are working toward that end. Even though the enforcement mechanism is not yet in place, you are STILL RESPONSIBLE for having this knowledge (as you have always been).

All I have left is CIS4980 which I plan to take in the Summer. This course does not have CSP prerequisites. Must I still take the exams?

YES! CSPs are a requirement for getting your degree at GSU. Once again, this is NOT A CIS DEPARTMENT INITIATIVE. All students will eventually be expected to have basic computer literacy skills. We will be the first University in the United States with this requirement. As we promote this fact in the media, ultimately, your GSU degree will serve you well in your post academic career.

Do I need to buy all the books to study for these tests? Combined, they become quite an expense.

Students tend to get over-anxious when it comes to any form of testing. Most of the exams are quite easy. We recommend you try the basic exams first without any type of preparation. Most of them you should be able to pass on your first try. If not, then buy the appropriate book.

I took the exams but could not find the ones for CSP 7 and 8. What do I do? Will I be withdrawn from my courses that have this prerequisite?

As of this date, the testing modules for CSP 7 and 8 were not ready. Thus, you will not be tested on these CSPs. However, you are still responsible for having this knowledge. Purchasing the text book on the Internet is HIGHLY RECOMMENDED. Eventually, when this module is put in place, you will have to take these exams as well.

I am a PhD student. Must I still take the exams?

YES. One goal of this initiative is to make the claim that ALL students at GSU have been tested for basic computer literacy.

Sample Test Question Selection Screen